Update on New Orleans Risk Assessment

Hurricane Flood-Depth Frequency Maps with Pumping

10 March 2008

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Director, IPET
University of Maryland

Interagency Performance Evaluation Task Force

…"to provide credible and objective scientific and engineering answers…."

~~Chief of Engineers~~

- **System**
- **Storm**
- **Performance**
- **Consequences**

Repair/Rebuild

- Report - Draft JUN06
- Report - Final MAR07

- **Risk**

Higher Protection

- Maps JUN07
- Maps AUG07
- Maps MAR08
- Report – Draft NOV07
- Report – Final MAY08

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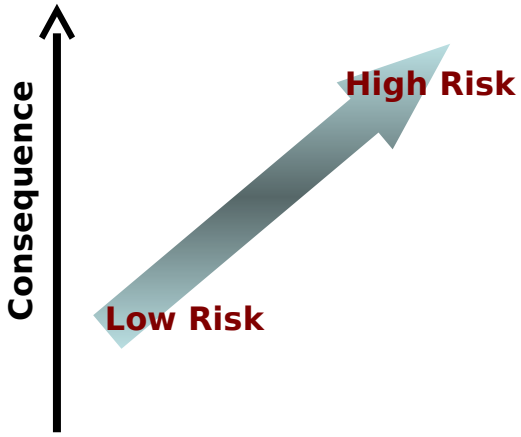
https://ipet.wes.army.mil ***NOLArisk.usace.army.mil***

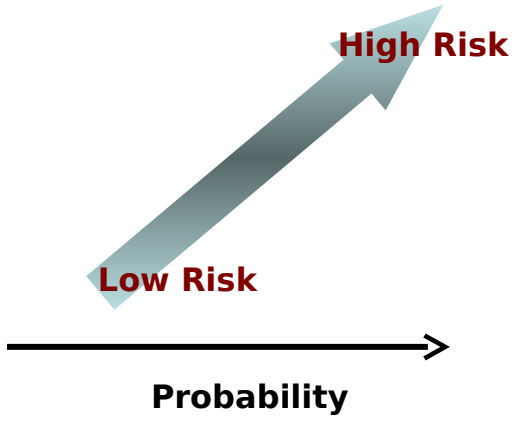
What is risk?

- **Insurance industry: risk = consequence**



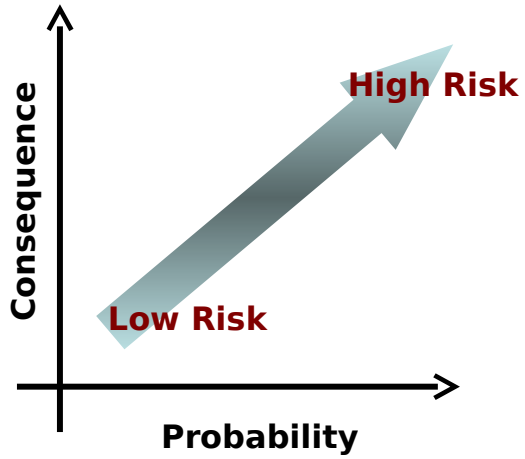
What is risk?

- Insurance industry: risk = consequence
- **Public health: risk = incidence (frequency or probability)**



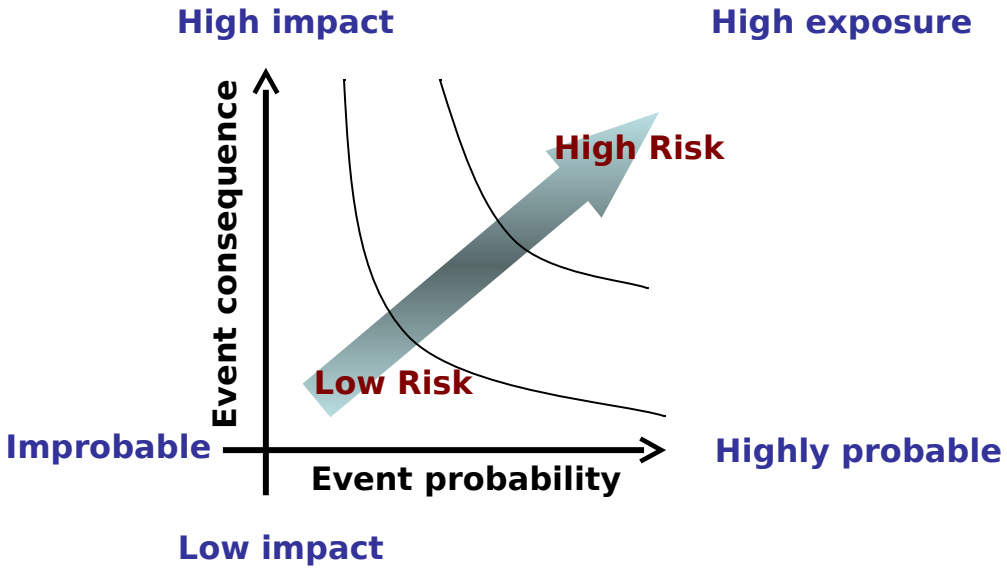
What is risk?

- Insurance industry: risk = consequence
- Public health: risk = incidence (frequency or probability)
- **Engineering and planning: risk = probability x consequence**



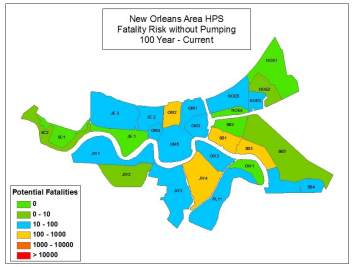
What is risk?

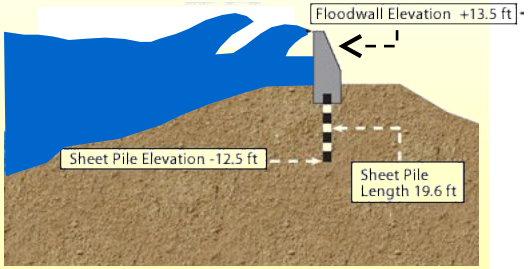
Risk = {probability, consequence}



Risk & Reliability Modeling

RISK = **Chance of Hazard** X **System Performance** X **Consequences**





Index of possible life & property losses

Based on **surge & wave** levels estimated at **138 locations** from

152 possible hurricanes

300 to 5000 Year storm events

Performance of entire 350-mile system

Three scenarios:

1) **Pre-Katrina**
2) **Current**
3) **Future**

Probability of Flooding

Potential Loss of Life**

Potential Property Damage**

**Based on Pre-Katrina population and property values

http://NOLArisk.usace.army.mil

Flooding Vulnerability

Chance of Hazard

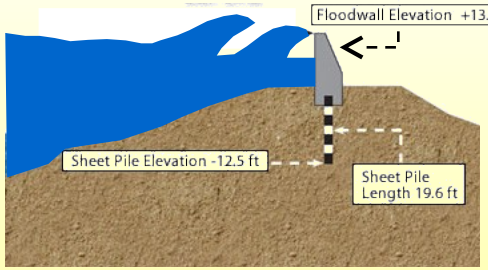
Surge & Wave levels estimated at 138 locations from

152 possible hurricanes

300 to 5000 Year storm events

X

System Performance



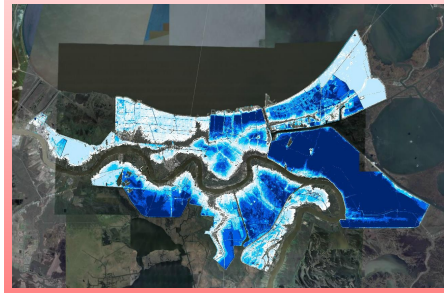
Performance of entire 350-mile system

1) Pre-Katrina
2) Current
3) Future

Reaches, Features and Transitions

=

Vulnerability to Flooding



Chance of Flooding and Flood Depth

By location and HPS Scenario

With / Without Pumping

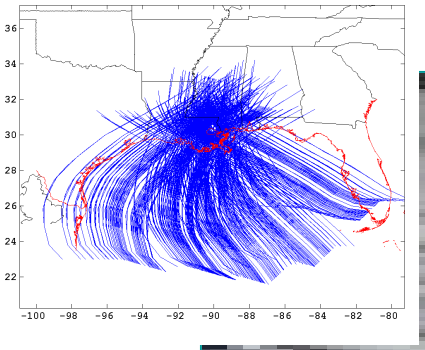
http://NOLArisk.usace.army.mil

Hazard Definition

Joint Probability Method – Optimum Sampling

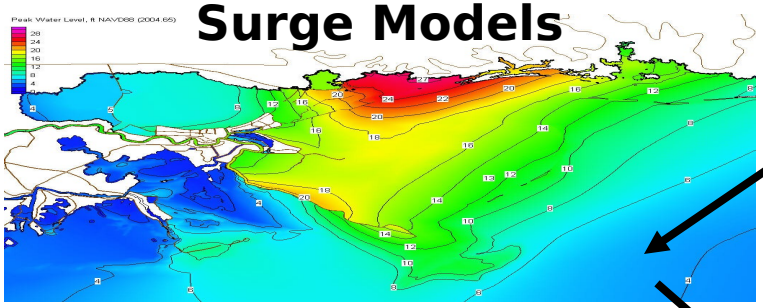
Prob (Hurricane Characteristics & Tracks)

(including climate variability)

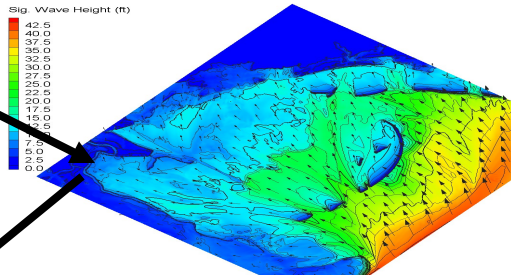


Wind Field – Planetary Boundary Layer Model

Surge Models

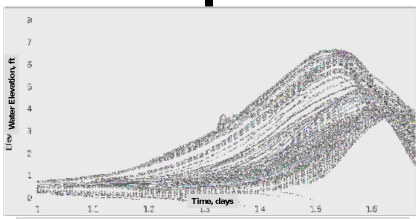


Wave Models



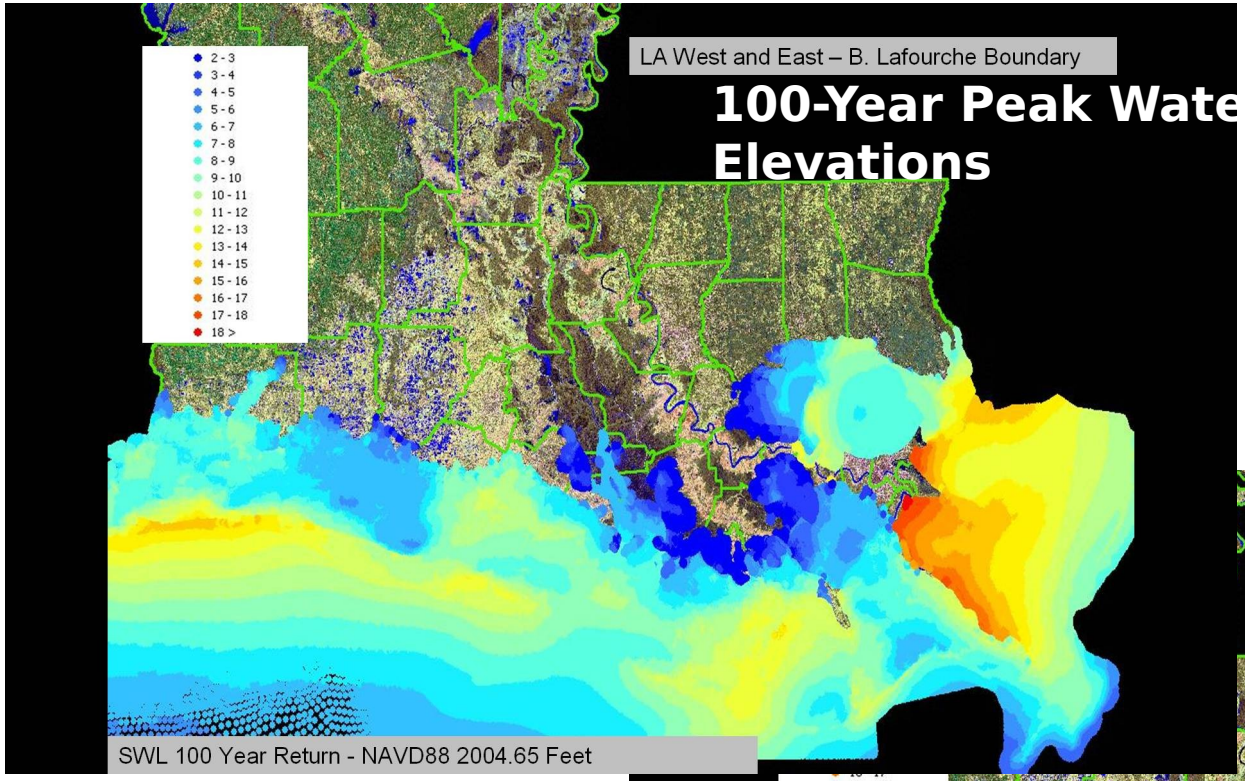
HPS Design

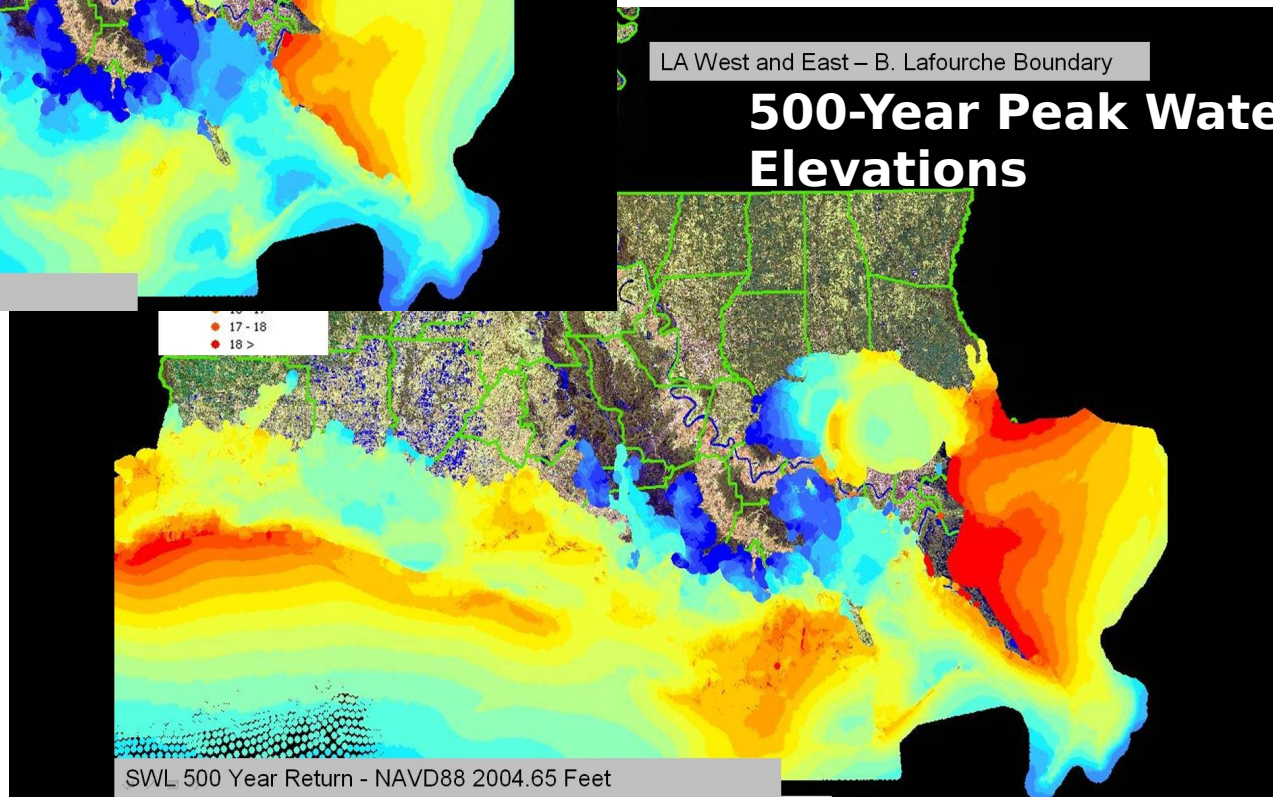
Time History of Surge and Waves by Location



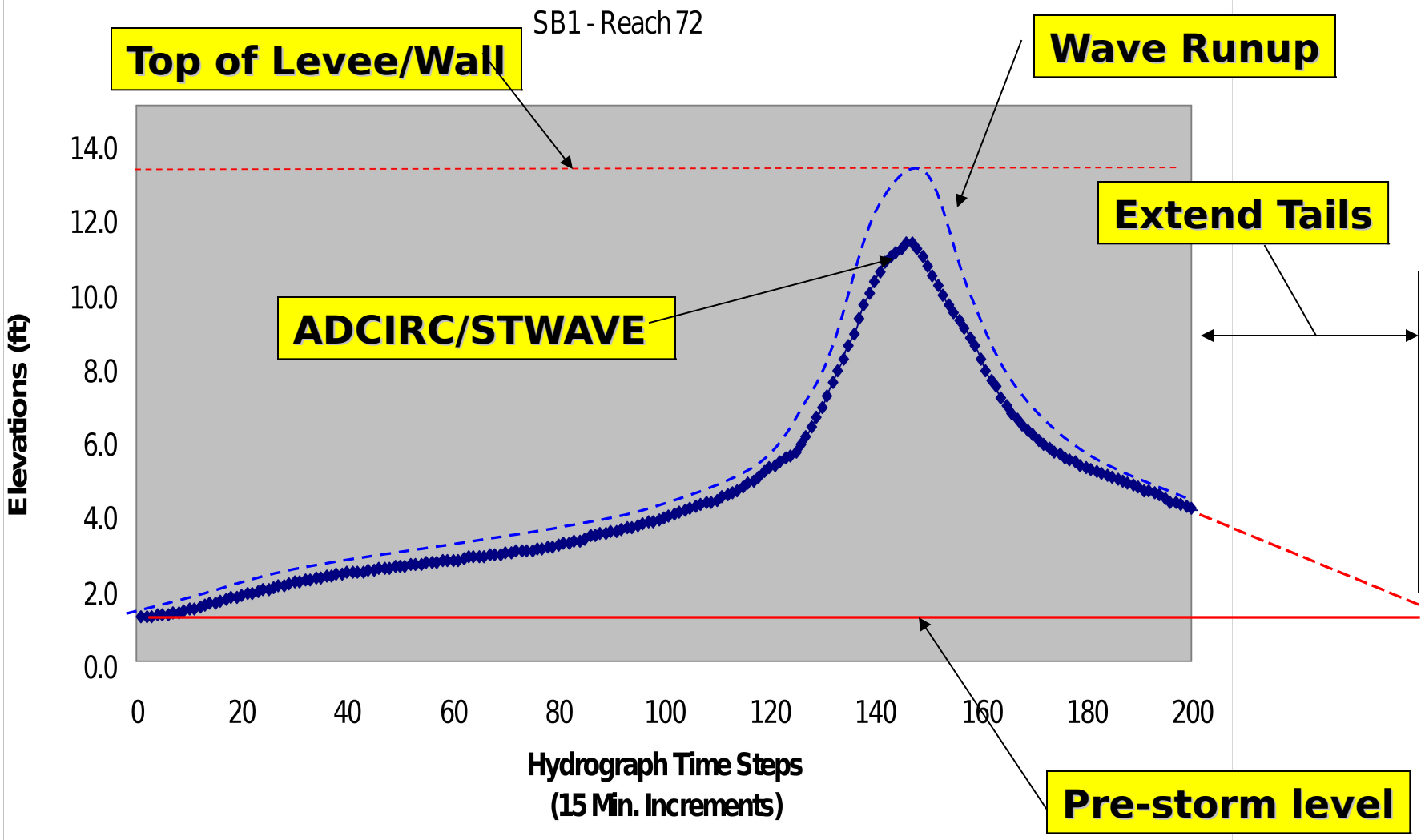
152 storm hydrographs at each of 138 locations for 3 HPS conditions

Hazard Maps

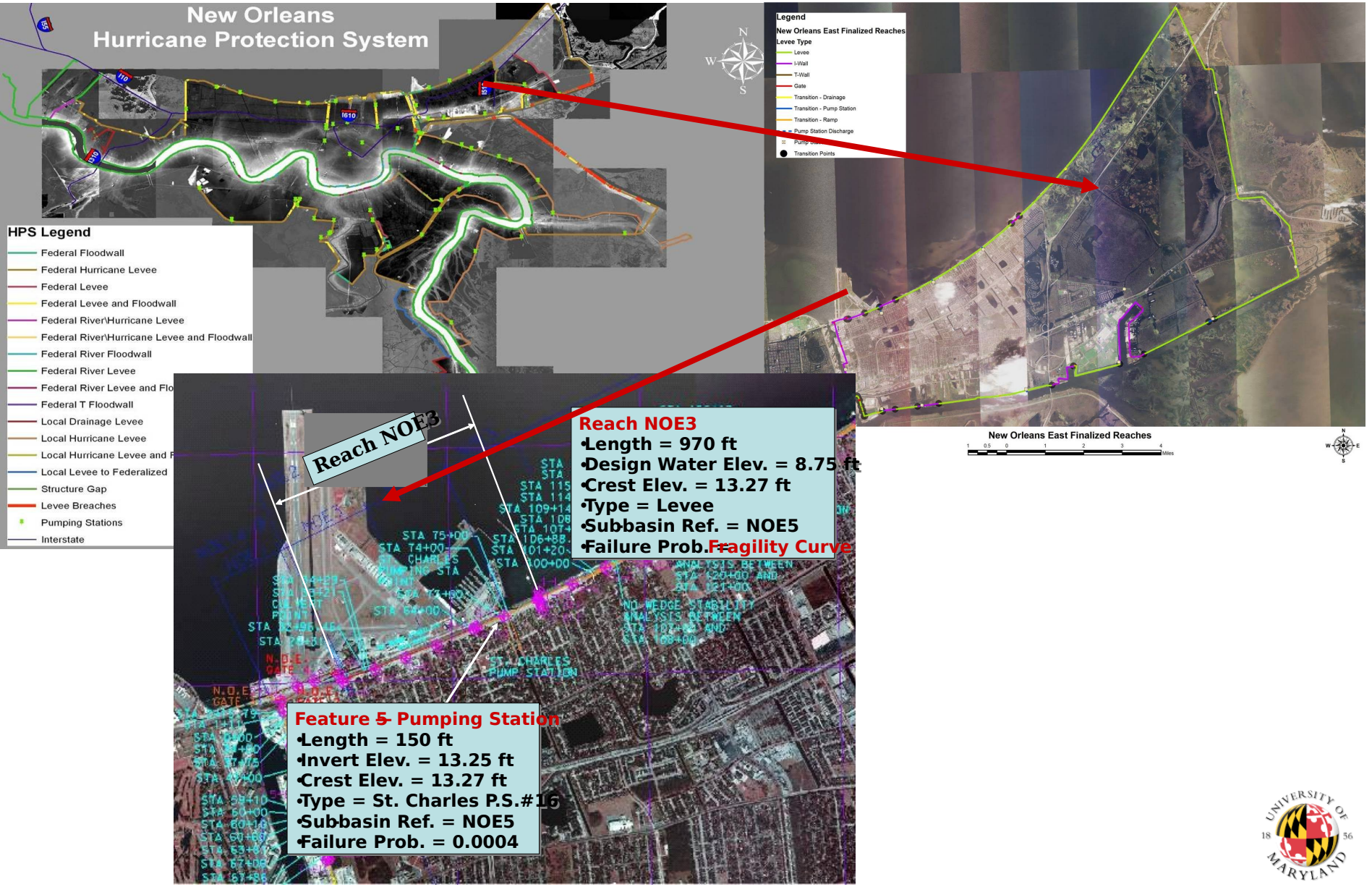

2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
7 - 8
8 - 9
9 - 10
10 - 11
11 - 12
12 - 13
13 - 14
14 - 15
15 - 16
16 - 17
17 - 18
18 >
LA West and East – B. Lafourche Boundary
100-Year Peak Wate
Elevations
SWL 100 Year Return - NAVD88 2004.65 Feet


17 - 18
18 >
LA West and East – B. Lafourche Boundary
500-Year Peak Wate
Elevations
SWL 500 Year Return - NAVD88 2004.65 Feet

Hurricane Water Level Processing



System Description



System Descriptions

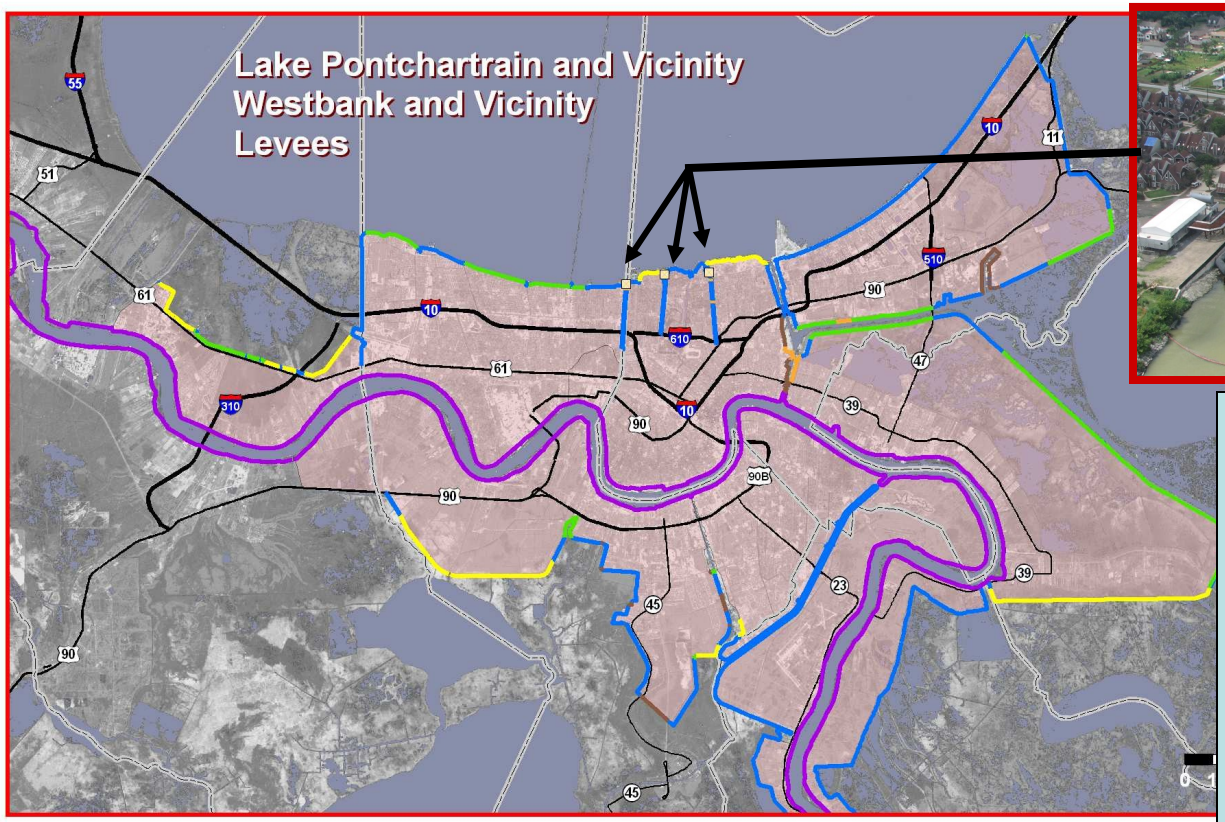
Pre-Katrina

- 29 August 2005 HPS
- 135 Reaches
- 178 Transitions
- 238 Features

Current

- 1 June 2007 HPS
- 138 Reaches
- 178 Transitions
- 197 Features

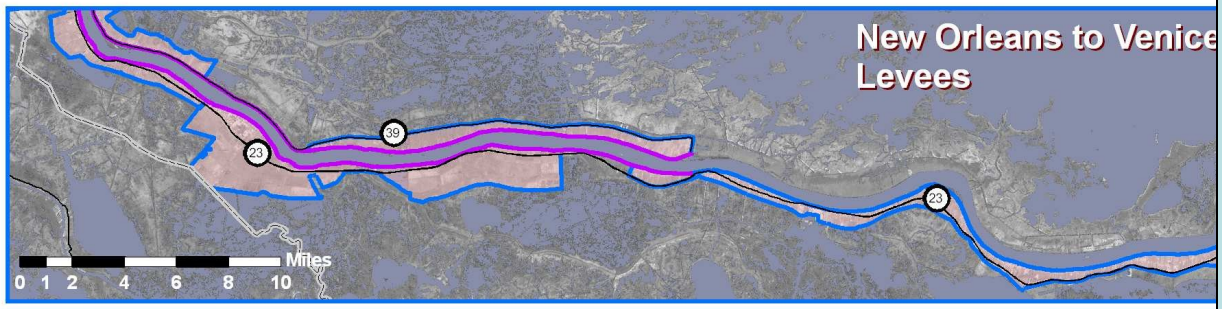
Current HPS (2007)



US Army Corps of Engineers®

Southeast Louisiana
Hurricane Protection System
and Major Evacuation Routes

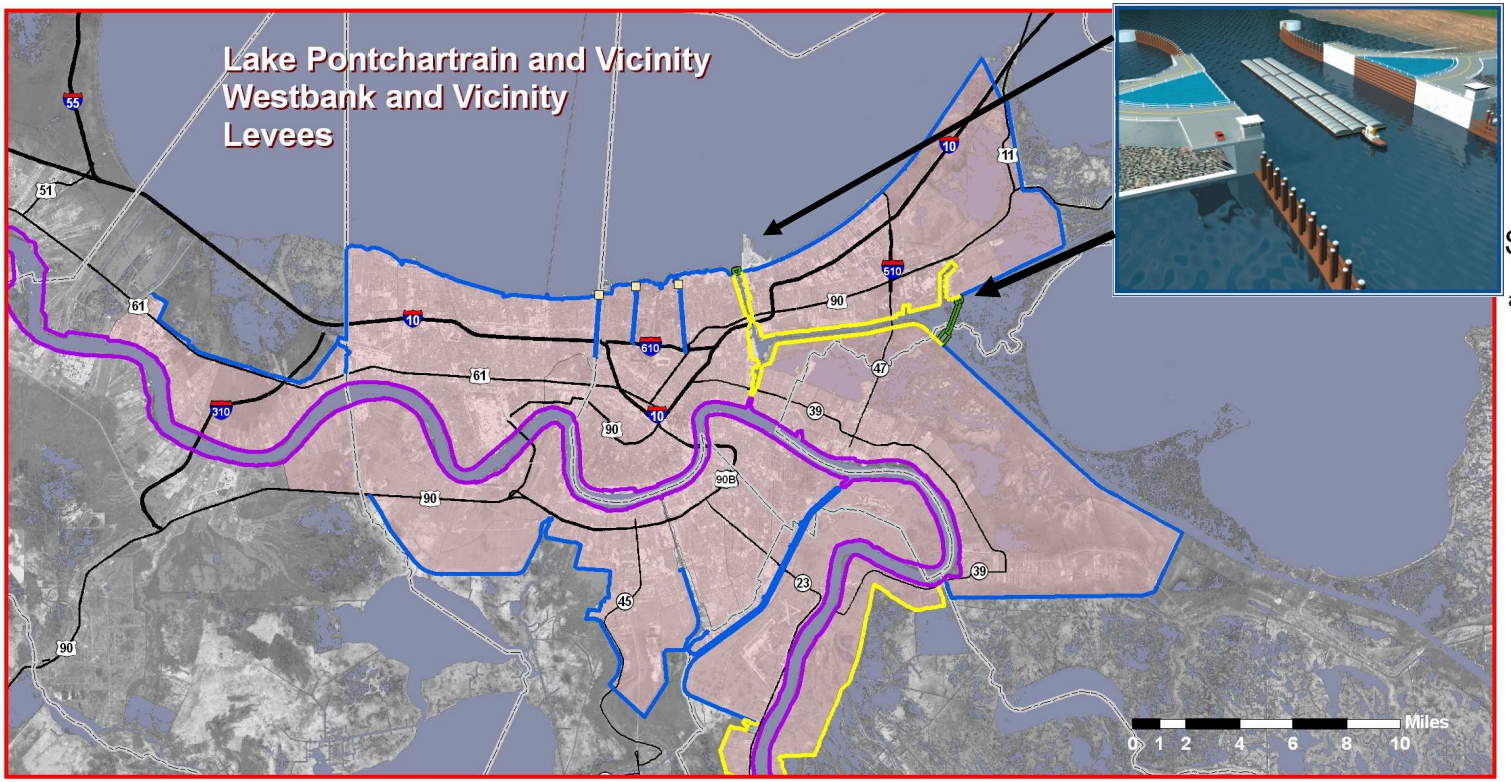
- Pump Stations
- New Floodwalls
- New/Raised Levees
- Advertised, Awarded or Underway Levees
- Added Scour Protection
- Existing Mississippi River Levees
- Existing HPS Levees
- Parish Boundaries
- Interstate
- Major Highway



Repaired system

- 220 total miles of levees and floodwalls repaired
- 2.3 mi new floodwall
- 22.7 mi new levee
- 195.3 mi scour repair (98 mi MRL completed 17 Mar)
- 3 interim gated closure structures (IGCS) with pumping
- 4 closure structure repairs

100 Year HPS (~2011)

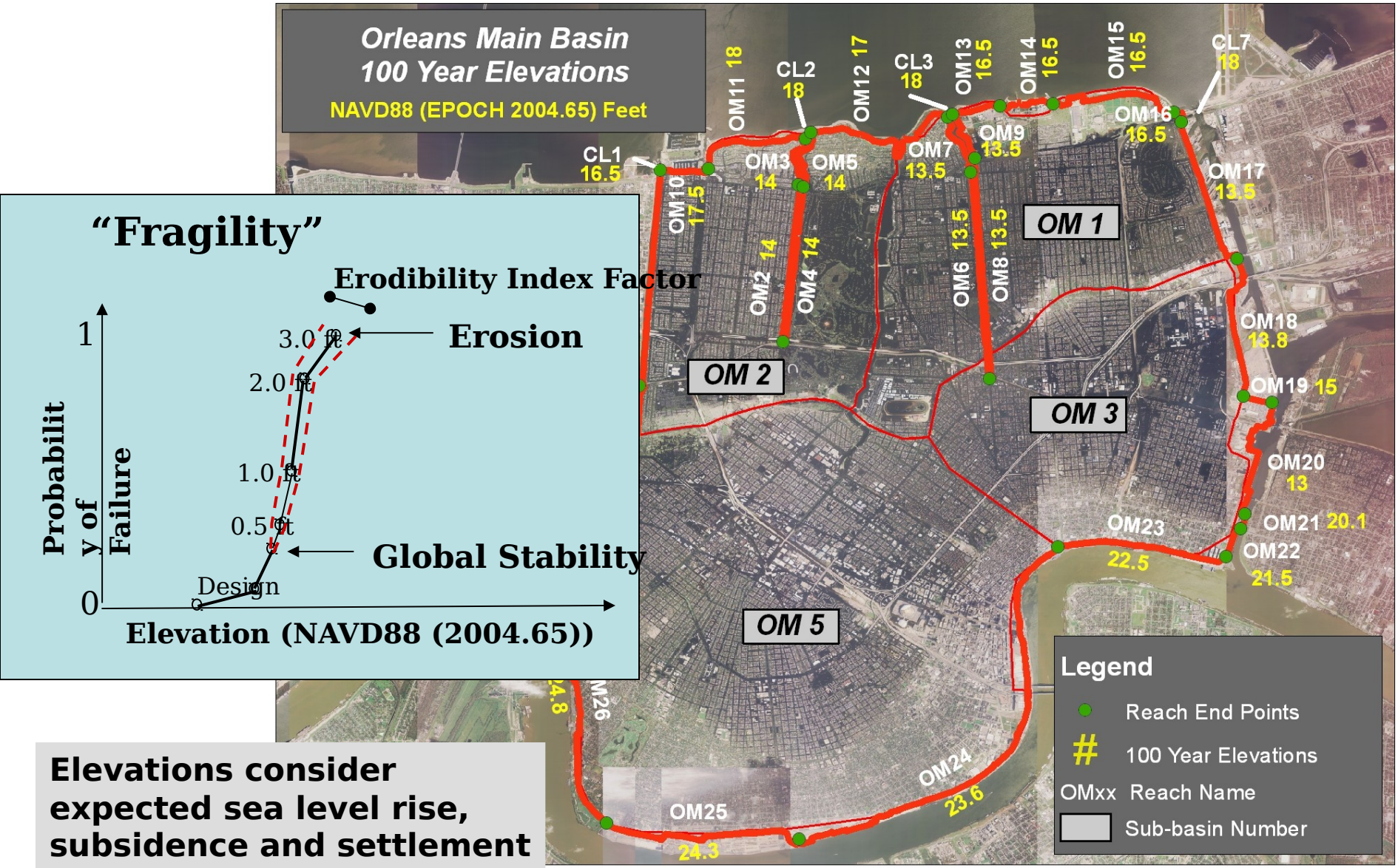


US Army Corps of Engineers®

Southeast Louisiana
Hurricane Protection System
and Major Evacuation Routes
100 Year Map

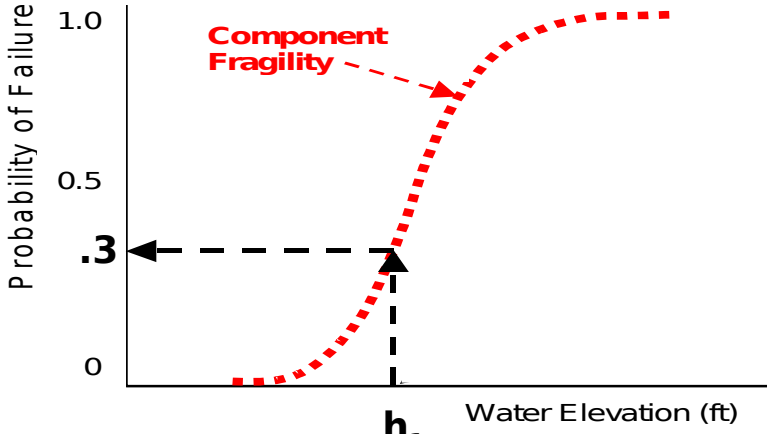
- Pump Stations
- Mississippi River Levees
- Authorized Levees
- IHNC Closures
- 100 Year Levees
- Parish Boundaries
- Interstate
- Major Highway

System Performance



Elevations consider expected sea level rise, subsidence and settlement

Systems Analysis for Probability of Flo



Rainfall Volume

Sub-basin Interflow

h1

.1

.9

Open Gates

Closed Gates

1.0

Overtopping

0.0

No Overtopping

.3

Breach

1.0

Pumps On

Volume 1 Branch Rate

0.0

Pumps Off

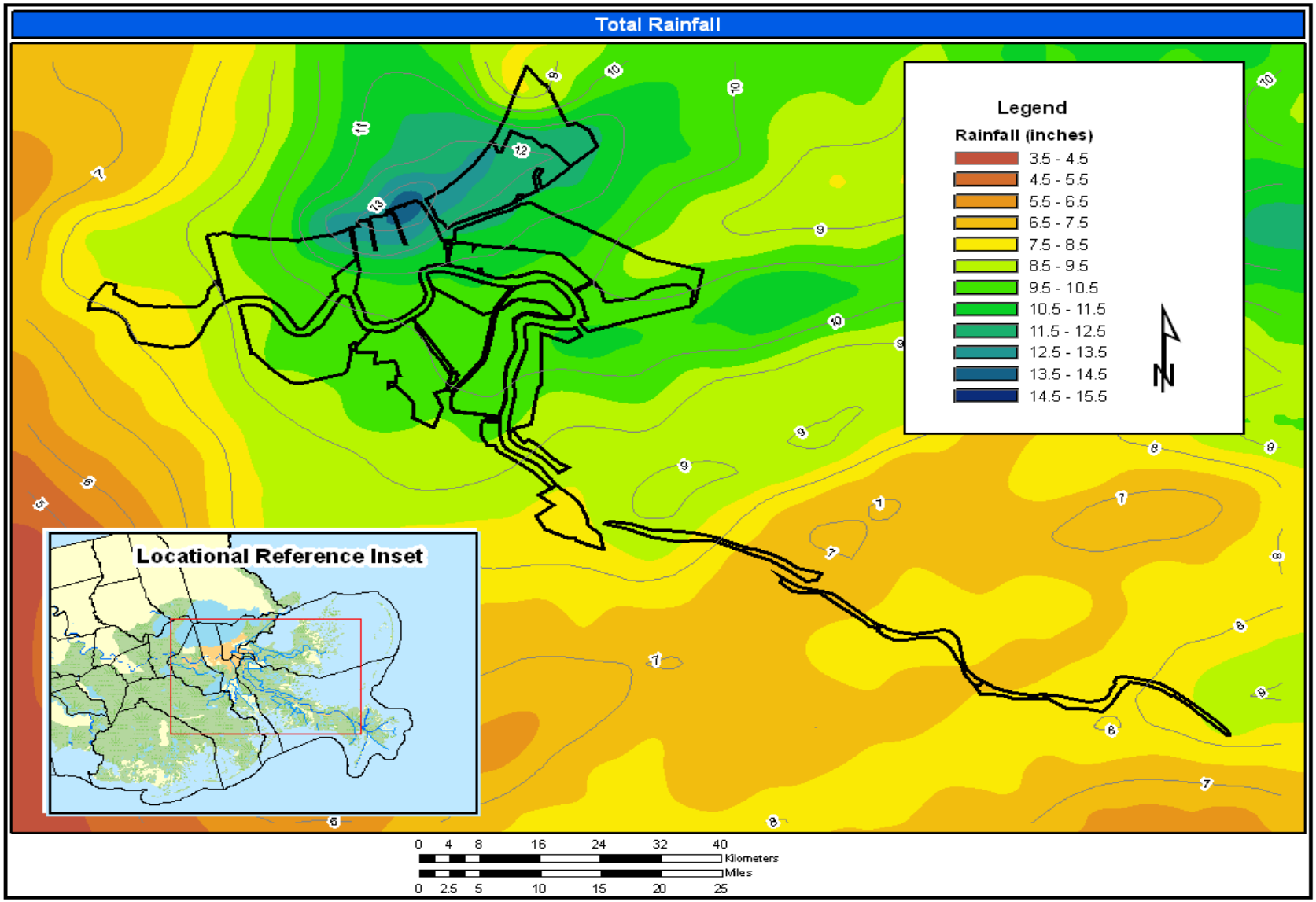
.7

No Breach

Volume 2 Branch Rate 2

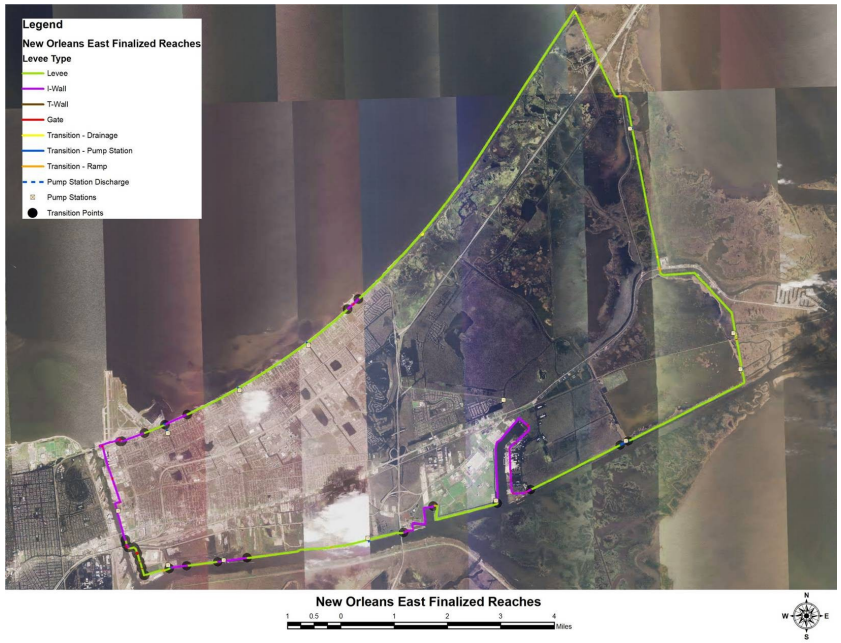
Volume 3 Branch Rate 3

Rainfall Estimates



Sub-basin Interflow Elevations, NOE

Subbasin	OW1	OW2	NOE1	NOE2	NOE3	NOE4	NOE5
OW1							
OW2							
NOE1				-8.593			-1.906
NOE2			-8.593		-3.391		-11.245
NOE3				-3.391		-0.824	-9.383
NOE4					-0.824		-1.706
NOE5			-1.906	-11.245	-9.383	-1.706	
OM1							
OM2							
OM3							



Pumping Capacity, Orleans Main

Orleans Main	Acres	Sq Miles	10 Year Rainfall, cf	Pumping Capacity, cfs
OM1	7.86	5032	1.42E+08	3720
OM2	6.56	4201	1.16E+08	14020
OM3	7.13	4562	1.29E+08	8420
OM4	3.11	1989	5.67E+07	0
OM5	17.55	11229	3.16E+08	10324
Basin Totals			7.60E+08	36484

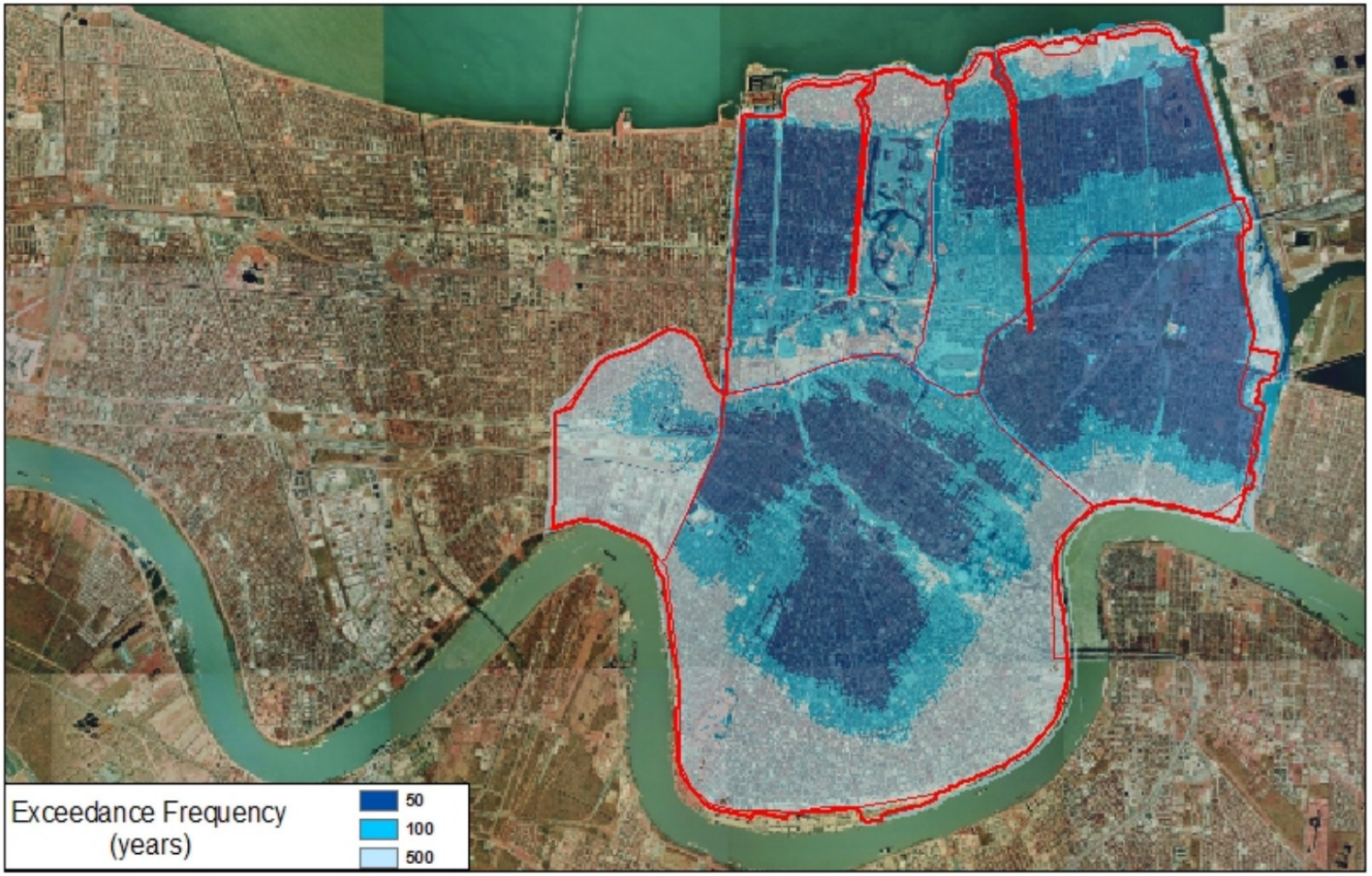
Hours of pumping dependent on storm size and area
Typically 8 to 12 hours

Process for Considering Pumping Capacity Impact

- Determine total sub-basin design pumping capacity
- Determine rainfall duration per storm from intensity curves (generally 6,8 or 10 hours)
- Determine volume of rain and runoff
- Assume pumps will perform at the assumed capacity (0, 50 or 100%)
- Determine volume of water that pumps could evacuate per storm at the selected capacity
- Subtract pump volume from rainfall to determine net volume
- If net volume is a positive value, replace rainfall with net volume.
- If net volume is a negative value, replace rainfall with net volume = zero.

Hurricane 50, 100 and 500-Year Floodplain Boundaries, Orleans Main

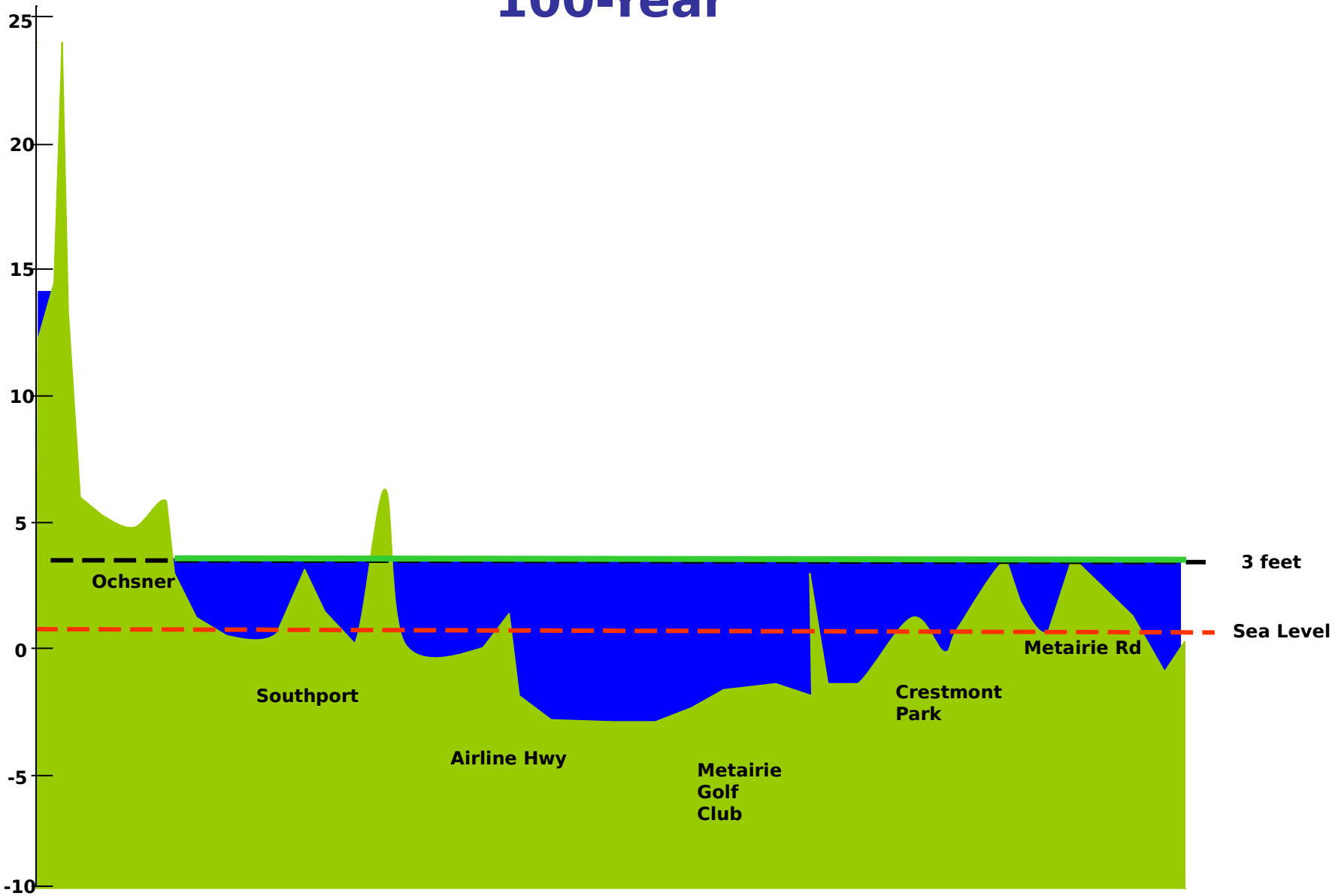
OM Current HPS Inundation (No Pumping with Wave Run-up)



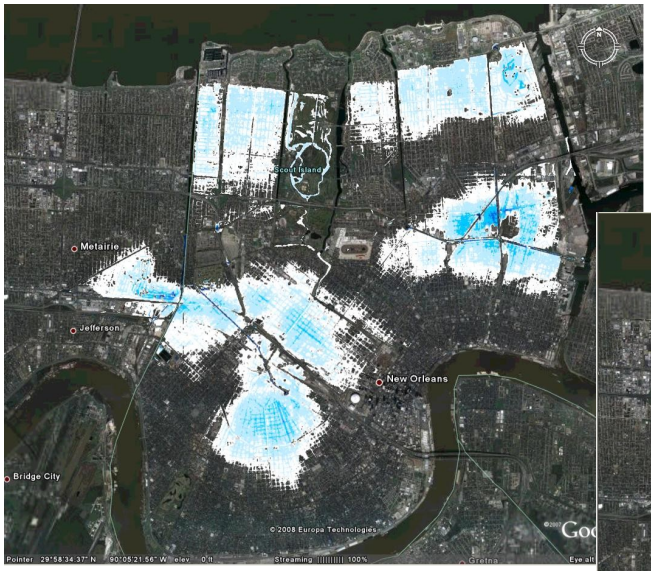
NOTES
- Evacuation has not been considered in the determination of fatalities.
- Elevation uncertainty values are for illustration only
- A return period of 1 in 50 years means there is a 2% chance every year of exceeding the plotted elevation, a 22% chance of exceeding the plotted elevation in 10 years and a 50% chance of exceeding the plotted elevation in 20 years.
- The performance of the pumping system has not been considered in the determination of the plotted elevations.

11/29/2007

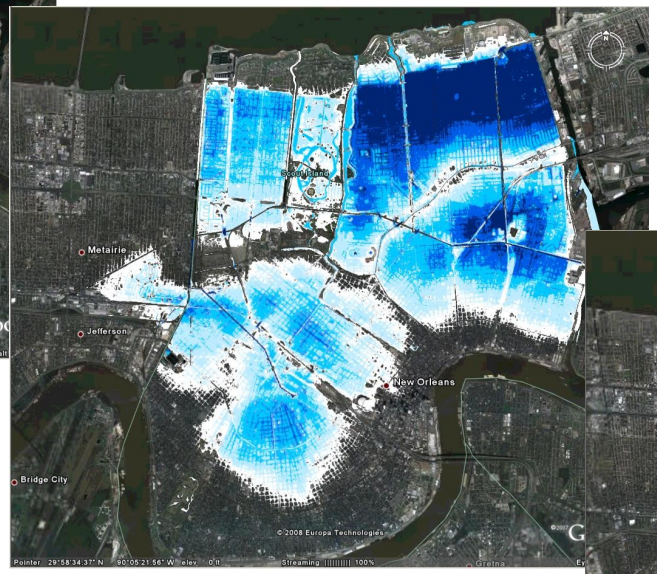
Flood Depth Profile, Old Metairie / Hoey's Basin, 100-Year



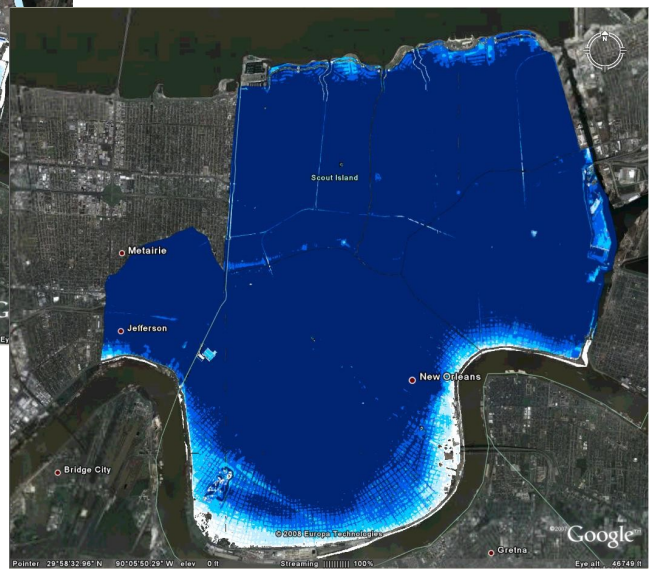
Flood Depth Maps



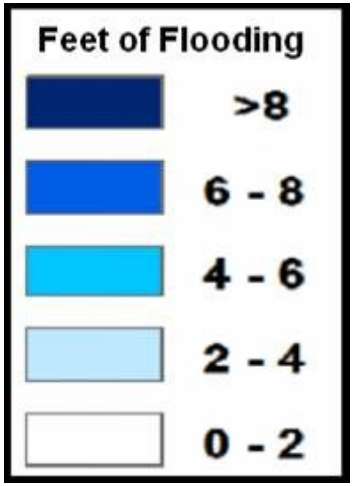
2007, 50-Year



2007, 100-Year



2007, 500-Year

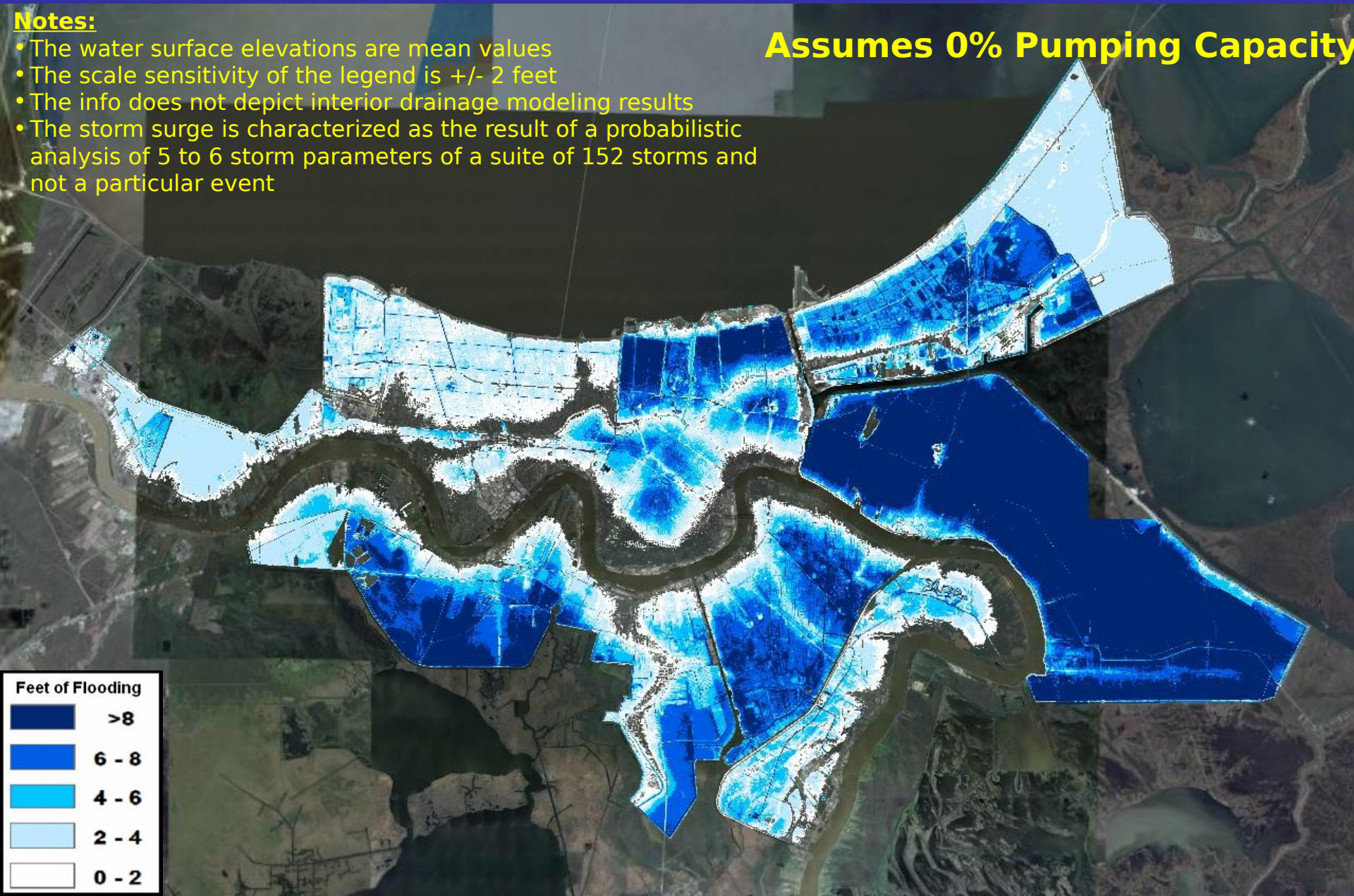


Before Katrina, you had a 1% chance every year of flooding this deep from Hurricanes

Notes:

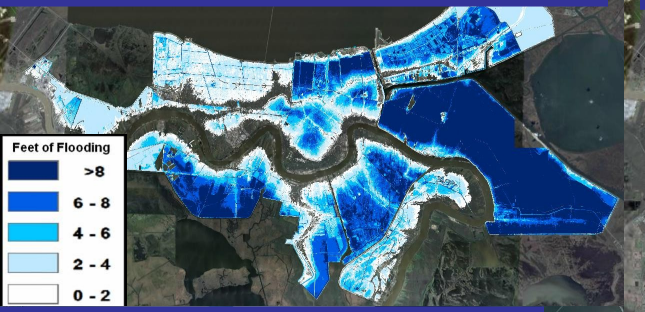
- The water surface elevations are mean values
- The scale sensitivity of the legend is +/- 2 feet
- The info does not depict interior drainage modeling results
- The storm surge is characterized as the result of a probabilistic analysis of 5 to 6 storm parameters of a suite of 152 storms and not a particular event

Assumes 0% Pumping Capacity

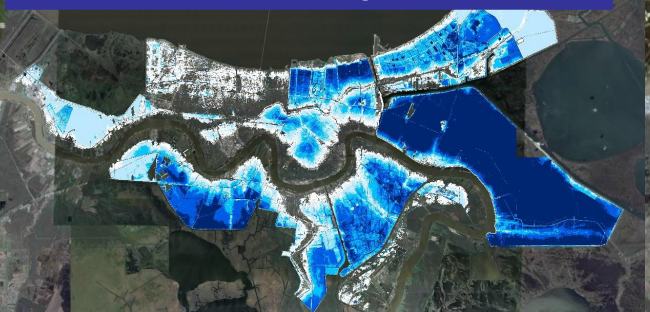


1% Hurricane Based Flood Depth Maps

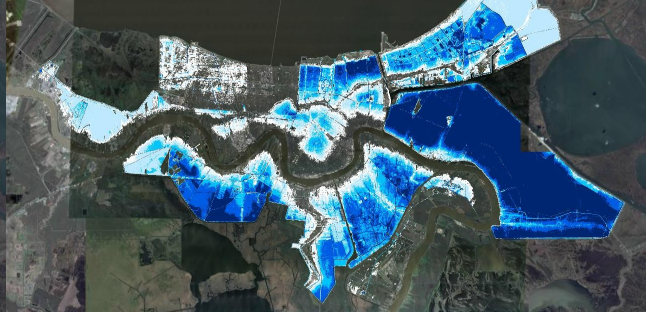
Pre-Katrina, 1% Hurricane Flood Depth, 0% Pumps



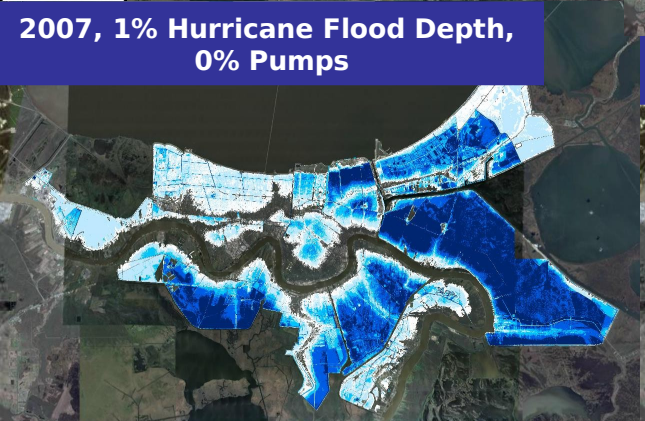
Pre-Katrina, 1% Hurricane Flood Depth, 50% Pumps



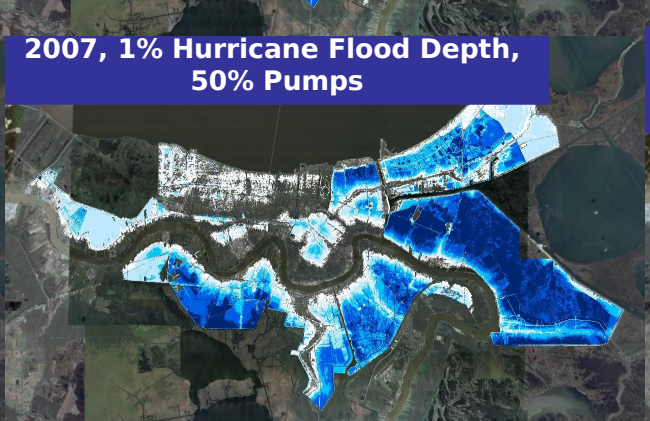
Pre-Katrina, 1% Hurricane Flood Depth, 100% Pumps



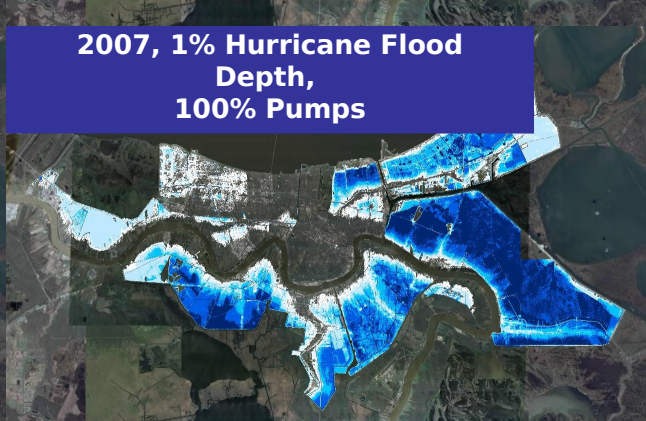
2007, 1% Hurricane Flood Depth, 0% Pumps



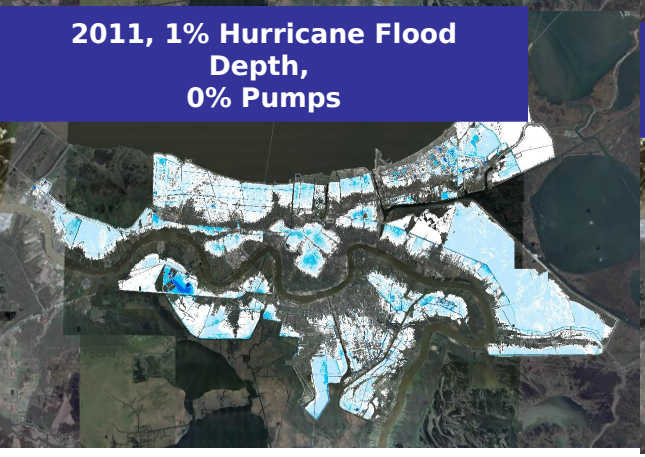
2007, 1% Hurricane Flood Depth, 50% Pumps



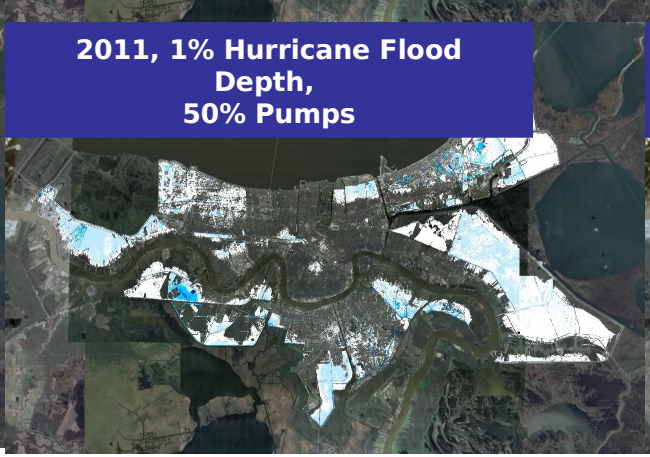
2007, 1% Hurricane Flood Depth, 100% Pumps



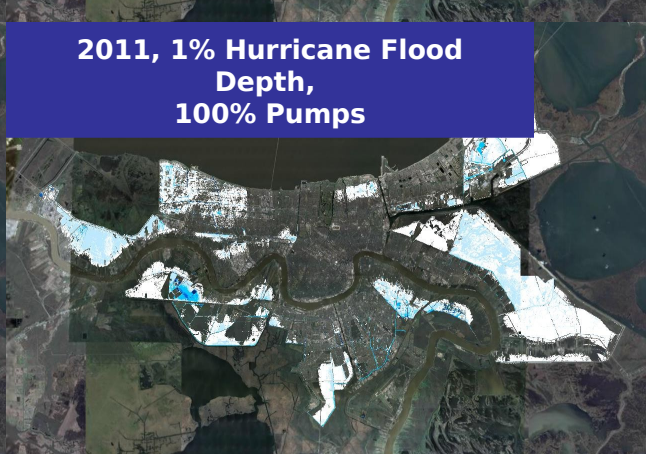
2011, 1% Hurricane Flood Depth, 0% Pumps



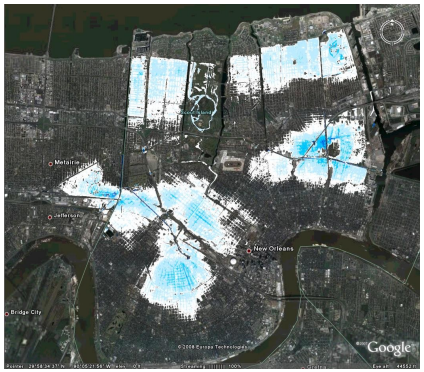
2011, 1% Hurricane Flood Depth, 50% Pumps



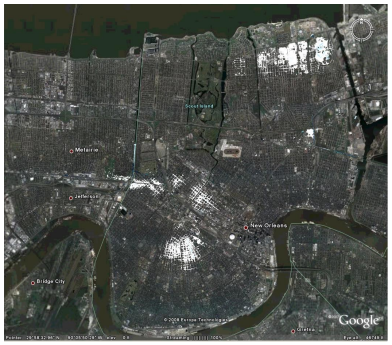
2011, 1% Hurricane Flood Depth, 100% Pumps



50 Year Hurricane Flood Depth, Orleans Main



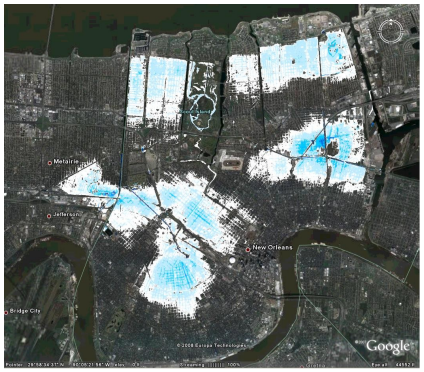
OM 2011, 50 YR, 0%



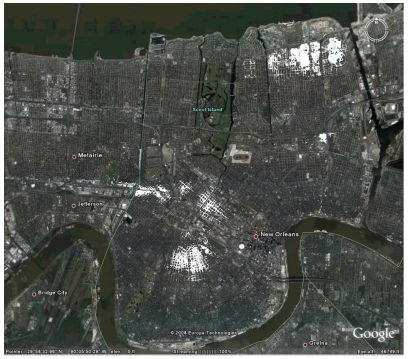
OM 2011, 50 YR, 50%

NO H2O

OM 2011, 50 YR, 100%



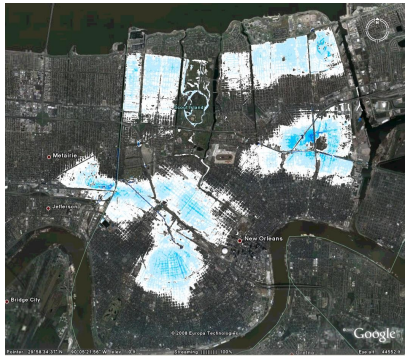
OM Jun07, 50 YR, 0%



OM Jun07, 50 YR, 50%

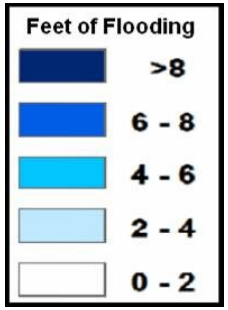
NO H2O

OM Jun07, 50 YR, 100%



OM Pre-K, 50 YR, 0%

NO H2O

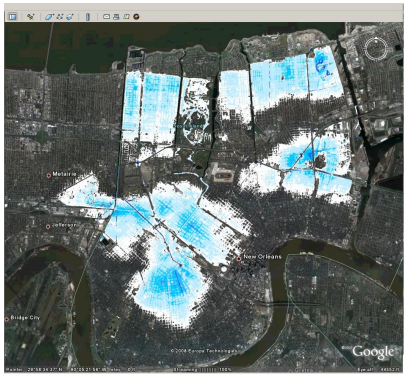


OM Pre-K, 50 YR, 50%

NO H2O

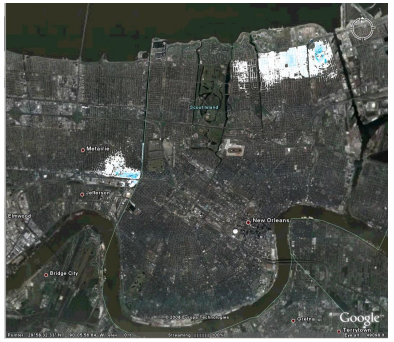
OM Pre-K, 50 YR, 100%

100 Year Hurricane Flood Depth, Orleans Main

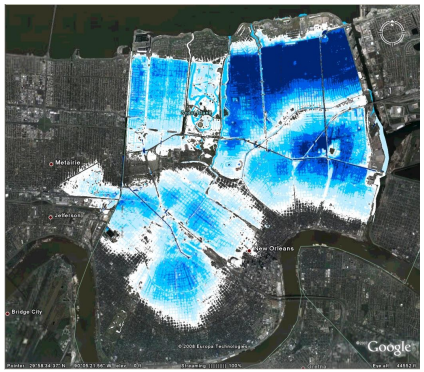


OM 2011, 100 YR, 0%

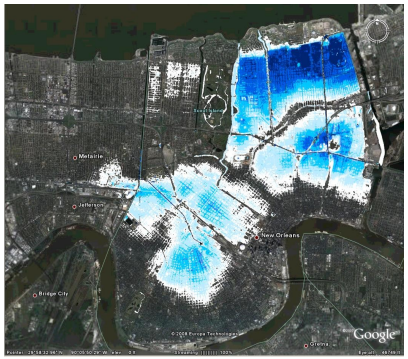
OM 2011, 100 YR, 50%



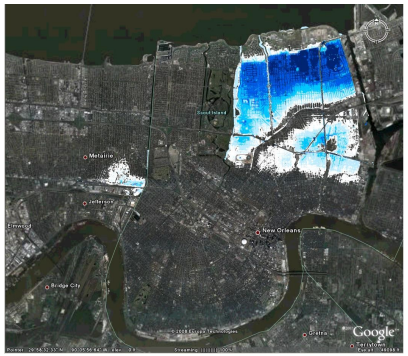
OM 2011, 100 YR, 100%



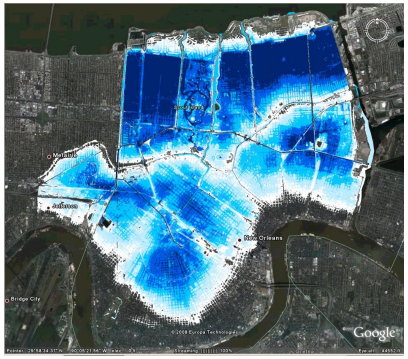
OM Jun07, 100 YR, 0%



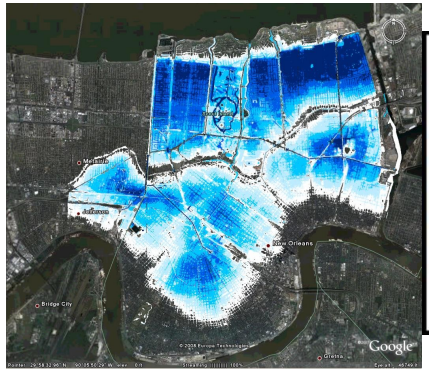
OM Jun07, 100 YR, 50%

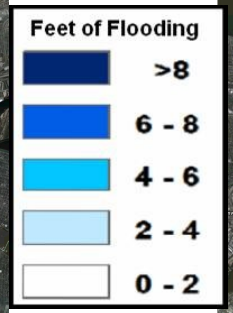


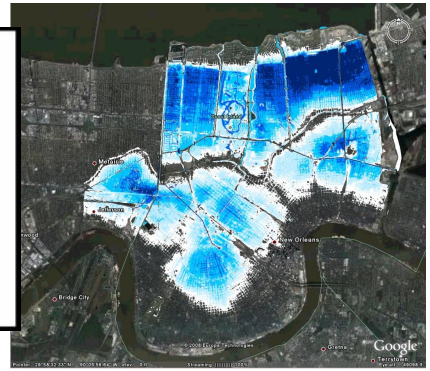
OM Jun07, 100 YR, 100%



OM Pre-K, 100 YR, 0%



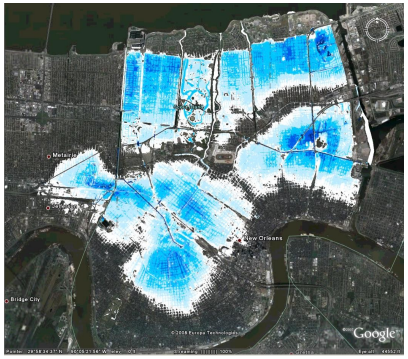




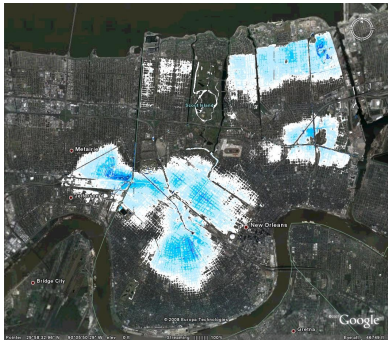
OM Pre-K, 100 YR, 50%

OM Pre-K, 100 YR, 100%

500 Year Hurricane Flood Depth, Orleans Main

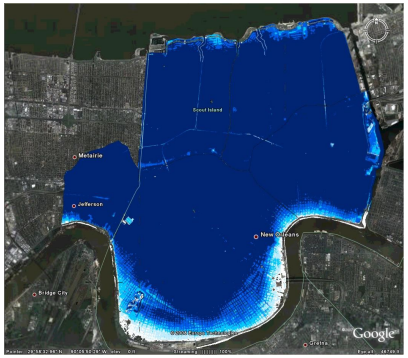


OM 2011, 500 YR, 0%

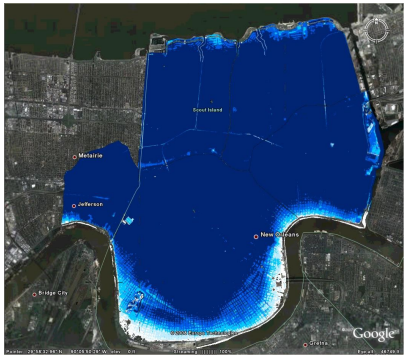


OM 2011, 500 YR, 50%

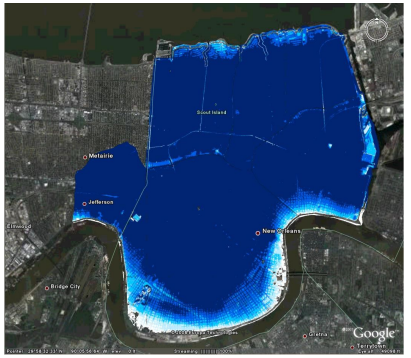
OM 2011, 500 YR, 100%



OM Jun07, 500 YR, 0%



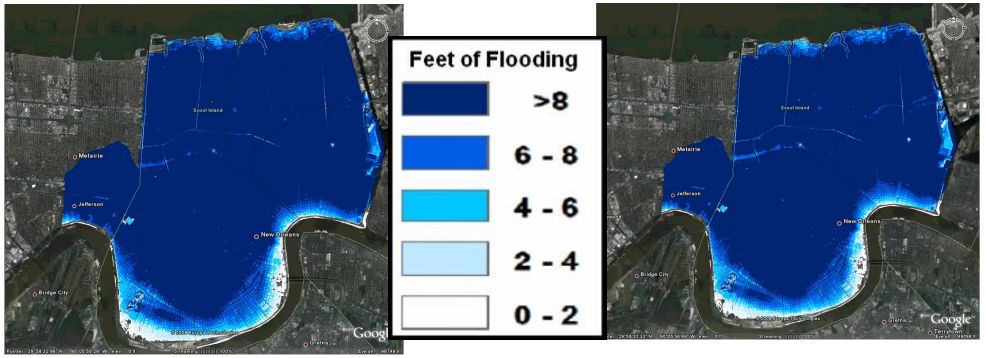
OM Jun07, 500 YR, 50%



OM Jun07, 500 YR, 100%

ALL H2O

OM Pre-K, 500 YR, 0%



OM Pre-K, 500 YR, 50%

OM Pre-K, 500 YR, 100%

Demystifying 100 years in New Orleans

100 year STORM

A 100-year storm is a statistical event that has a 1% chance of occurring each year

The 1% chance is based on the combined chances of a storm of a certain size and intensity following a certain track

Different combinations of size and intensity and track can result in a 100-year storm

100-year storms do not necessarily create a 100-year surge (water level) or a 100-year flood

Rita was about a 100-year storm

100 year WATER LEVEL

A 100-year water level is a statistical event that has a 1% chance of occurring each year at a given location

The 1% chance is based on water levels that would be created by a wide variety of storms. 99 % of the time water levels would be less

The 100-year water level can be quite different in different locations

Many storms can create the 100-year water level

100 year LEVEL OF PROTECTION

Structures designed to be at elevations that will withstand the 100-year water level

Not a statistical level but a deliberate design, based on the 100-year water level, expected subsidence and sea level rise for the life of the project, expected wave runup and freeboard against overtopping.

Since these factors can all vary with location, The100-year design elevations are not necessarily the same at every location

100 year FLOOD

A 100-year flood is a statistical event that has a 1% chance of occurring each year in a given area

The 1% chance is based on how often flood waters in a protected area would be higher than certain elevations

On the average, you would experience the 100-year flood level once every 100 years.

Changes in the capability of protection measures and pumping capacities can dramatically change the 100-year flood elevation